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Government
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Patent Office

Ottawa, Canada
K1A 0G9

(11) (C) 1,296,993

(21) 550,725

(22) 1987/10/30

(45) 1992/03/10

(52) 164-16

C.L. CR. 51-7

(51) INTL.CL. ⁵ B24C-7/00

(19) (CA) **CANADIAN PATENT** (12)

(54) Abrasive-Jet Cutting System

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(57) 20 Claims

Canada

AN ABRASIVE-JET CUTTING SYSTEM

Abstract of the Disclosure

The novel system discloses both a batch operation and a continuous operation for supplying pressured liquid and a pressured slurry to an abrasive-jet cutting nozzle. In the batch operation, a single vessel for receiving
5 and pressuring slurry is provided and this vessel goes off line, to be recharged with slurry, when it has disgorged its contents to the nozzle. In the continuous operation, a pair of such vessels are provided, and one supplies the nozzle with slurry while the other, having
10 been emptied, is recharged with slurry; valves switch therebetween, to put a re-charged vessel on line, and an emptied one re-charging, to maintain a continuous slurry input for the nozzle.

This invention pertains to water-jet cutting systems, and in particular, to such systems which are augmented with an abrasive slurry and, accordingly, are defined as abrasive-jet cutting systems.

- 5 In my co-pending patent application, Serial No. 550,430
filed 28 November 1987, and titled "Liquid/Abrasive Jet
Cutting Apparatus", I set forth a novel means for
producing an efficient abrasive-jet with a customary
pump, in lieu of a high-pressure intensifier, and
10 without need for high-pressure lines and fittings. In
this instant disclosure, I set forth an abrasive-jet
cutting system having a capability for batch operation,
and such a system having a capability for continuous
operation, for supplying pressured slurry to the
15 jet-cutting nozzle.

- It is an object of this invention, then, to set forth an
abrasive-jet cutting system, comprising first means
comprising a supply of pressured liquid; a jet-cutting
nozzle; first conduit means for communicating said first
20 means with said nozzle for conducting pressured liquid
to said nozzle; second means comprising a reservoir of
slurry; third means comprising a given slurry-confining
and -pressurizing vessel; second conduit means for
communicating said reservoir with said vessel for
25 supplying slurry from said reservoir to said vessel for
confinement therein; third conduit means for
communicating said first means with said vessel for
conducting pressured liquid to said vessel for
pressurizing vessel-confined slurry; fourth conduit
30 means for communicating said vessel with said nozzle for
conducting pressurized slurry to said nozzle; and a
given, single, valve, interpositioned between said
vessel, said reservoir, and said nozzle, having means

operative in a first mode (a) to effect communication between said vessel and said reservoir, and (b) to prohibit communication between said vessel and said nozzle, and having means operative in a second mode (c) to effect communication between said vessel and said nozzle, and (d) to prohibit communication between said vessel and said reservoir.

It is also an object of this invention to disclose an abrasive-jet cutting system, comprising first means comprising a supply of pressured liquid; a jet-cutting nozzle; first conduit means for communicating said first means with said nozzle for conducting pressured liquid to said nozzle; second means comprising a reservoir of slurry; third means comprising a plurality of slurry-confining and -pressurizing vessels; second conduit means for communicating said reservoir with said vessels of said plurality thereof for supplying slurry from said reservoir to said vessels for confinement therein; third conduit means for communicating said first means with said vessels for conducting pressured liquid to said vessels for pressurizing vessels-confined slurry; fourth conduit means for communicating said vessels with said nozzle for conducting pressurized slurry to said nozzle; and a given, single valve, interpositioned between said vessels, said reservoir, and said nozzle, having means operative in a first mode (a) to effect communication between one of said vessels and said reservoir, and (b) to prohibit communication between said one vessel and said nozzle, and having means operative in a second mode to effect communication between said one vessel and said nozzle, and (d) to prohibit communication between said one vessel and said reservoir.

Further objects of this invention, as well as the novel features thereof, will become more apparent by reference to the following description taken in conjunction with the accompanying figures in which:

5 Figure 1 is a schematic diagram of the novel system which, in the first embodiment thereof, comprises a batch processing arrangement; and

10 Figure 2 is a schematic diagram of the novel system which, in this second embodiment thereof, comprises a continuous processing arrangement.

As shown in Figure 1, the system 10 comprises a tank 12 which comprises a store of water. A tank outlet line 14 supplies water to an intensifier 16 for pressurization of the water. Lines 18 and 20 conduct the pressured
15 water to an abrasive-jet nozzle 22.

A vessel 24 is provided for confining slurry therein, and for pressuring the confined slurry by means of a piston 26 movable therein. A slurry reservoir 28, having an agitator 30 operatively disposed therein,
20 charges the vessel 24 with a supply of slurry when (a) the vessel slurry has been depleted, and (b) the rotary valve 32 is positioned, as shown, to communicate lines 34 and 36.

Vessel 24 has a return line 38 for water to return to
25 the tank, pursuant to a translation of the piston 26 in the arrowed direction (as the vessel 24 is charged with slurry). To accommodate and to prohibit water conduct through line 38, the latter has a control valve 40 interpositioned therein. Valve 40 is kept in its closed
30 position when vessel 24 is being supplied with pressured

water from intensifier 16, and is kept in its open position when vessel 24 is being supplied with a new charge of slurry. To insure these conditions, valve 40 is coupled to valve 32, as the dashed linkage 42
5 signifies, for coincident operation.

As to supplying the vessel 24 with pressured water from pump 16, to pressurize the slurry confined in the vessel, a line 44 communicates with line 18, via a throttle valve 46, for the purpose.

10 When the vessel 24 is fully charged with slurry from the reservoir 28, valves 32 and 40 are operated; valve 32 is turned ninety degrees to the left (i.e., counterclockwise), to communicate line 36 with a nozzle inlet line 48, and coincidentally valve 40 is shut off.
15 Pressured water, then, enters the vessel 24 to force the piston 26 downwardly (a) to pressurize the slurry in the vessel 24, and (b) to expel slurry therefrom, into the nozzle 22, via line 48. Nozzle 22 is of the same structure as disclosed in my aforecited co-pending
20 patent application.

The aforesaid, then, comprises the system 10 in a batch processing embodiment. In Figure 2, I depict a continuous processing embodiment of the invention; same or similar index numbers, as employed in Figure 1,
25 denote same or similar elements and/or components in this Figure 2.

The Figure 2 system 10a has a pair of vessels 24 and 24a which function alternatively. That is, as one of the vessels is being re-charged with slurry from the
30 reservoir 28, the other is supplying pressured slurry to the nozzle 22.

In this Figure 2, continuous processing arrangement, valve 32a, interpositioned between the reservoir 28, nozzle 22 and vessels 24 and 24a, serves a dual function. In the positioning shown, it communicates
5 line 34 with line 36, and communicates line 36a with line 48. When turned ninety degrees (in either direction), valve 32a communicates line 34 with line 36a, and line 36 with line 48.

The simple open/closed valve in line 38 (in Figure 1) is
10 now supplanted with a rotary valve 40a. Valve 40a has two operative positionings, and conducts water therethrough in both. As shown, it communicates fully through line 38, to allow vessel 24 to be re-charged with slurry, and it communicates line 38a with line 44
15 to expel pressured slurry from the vessel 24a. In its alternative positioning, valve 40a interrupts common flow through both legs of line 38. It connects vessel 24, through one leg of line 38, to line 44, whereby vessel 24 expels pressured slurry to the nozzle 22.
20 Too, in the latter positioning, valve 40a communicates line 38a with the other leg of line 38 to allow vessel 24a to return water to the tank.12.

Valves 32a and 40a, of course, are ganged for coincident operation via the dashed linkage 42.

25 While I have described my invention in connection with specific embodiments thereof, it is to be clearly understood that this is done only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the appended claims.

CLAIMS

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

- 1 1. An abrasive-jet cutting system, comprising:
 - 2 first means comprising a supply of pressured liquid;
 - 3 a jet-cutting nozzle;
 - 4 first conduit means for communicating said first
 - 5 means with said nozzle for conducting pressured liquid to
 - 6 said nozzle;
 - 7 second means comprising a reservoir of slurry;
 - 8 third means comprising a given slurry-confining and
 - 9 -pressurizing vessel;
 - 10 second conduit means for communicating said reservoir
 - 11 with said vessel for supplying slurry from said reservoir
 - 12 to said vessel for confinement therein;
 - 13 third conduit means for communicating said first
 - 14 means with said vessel for conducting pressured liquid to
 - 15 said vessel for pressurizing vessel-confined slurry;
 - 16 fourth conduit means for communicating said vessel
 - 17 with said nozzle for conducting pressurized slurry to
 - 18 said nozzle; and
 - 19 a given, single, valve, interpositioned between said
 - 20 vessel, said reservoir, and said nozzle, having means op-
 - 21 erative in a first mode (a) to effect communication be-
 - 22 tween said vessel and said reservoir, and (b) to prohibit
 - 23 communication between said vessel and said nozzle, and
 - 24 having means operative in a second mode (c) to effect
 - 25 communication between said vessel and said nozzle, and
 - 26 (d) to prohibit communication between said vessel and
 - 27 said reservoir.
- 1 2. An abrasive-jet cutting system, according to claim 1,
 - 2 wherein:
 - 3 said first means comprises a store of liquid, a

4 liquid pressuring device, and means for conducting liquid
5 from said store to said device.

1 3. An abrasive-jet cutting system according to claim 2,
2 wherein:
3 said device comprises an intensifier.

1 4. An abrasive-jet cutting system according to claim 1,
2 further including:
3 means interpositioned between said first means and
4 said vessel for selectively controlling flow of pressured
5 liquid from said first means to said vessel.

1 5. An abrasive-jet cutting system, according to claim 4,
2 wherein:
3 said flow-controlling means comprises another valve
4 operatively interposed in said third conduit means.

1 6. An abrasive-jet cutting system, according to claim 2,
2 further including:
3 fifth conduit means for communicating said vessel
4 with said store for conducting liquid from said vessel to
5 said store.

1 7. An abrasive-jet cutting system, according to claim 6,
2 further including:
3 means, interpositioned in said fifth conduit means,
4 selectively operative for opening and closing said fifth
5 conduit means to fluid conduct therethrough.

1 8. An abrasive-jet cutting system, comprising:
2 first means comprising a supply of pressured liquid;
3 a jet-cutting nozzle;
4 first conduit means for communicating said first
5 means with said nozzle for conducting pressured liquid to

6 said nozzle;
7 second means comprising a reservoir of slurry;
8 third means comprising a plurality of
9 slurry-confining and -pressurizing vessels;
10 second conduit means for communicating said reservoir
11 with said vessels of said plurality thereof for supplying
12 slurry from said reservoir to said vessels for confine-
13 ment therein;
14 third conduit means for communicating said first
15 means with said vessels for conducting pressured liquid
16 to said vessels for pressurizing vessels-confined slurry;
17 fourth conduit means for communicating said vessels
18 with said nozzle for conducting pressurized slurry to
19 said nozzle; and
20 a given, single valve, interpositioned between said
21 vessels, said reservoir, and said nozzle, having means
22 operative in a first mode (a) to effect communication be-
23 tween one of said vessels and said reservoir, and (b) to
24 prohibit communication between said one vessel and said
25 nozzle, and having means operative in a second mode (c)
26 to effect communication between said one vessel and said
27 nozzle, and (d) to prohibit communication between said
28 one vessel and said reservoir.

1 9. An abrasive-jet cutting system, according to claim 8,
2 wherein:
3 said given, single valve comprises means operative in
4 said first mode to effect communication between another
5 of said vessels and said nozzle.

1 10. An abrasive-jet cutting system, according to claim 8,
2 wherein:
3 said given, single valve comprises means operative in
4 said first mode to prohibit communication between another
5 of said vessels and said reservoir.

- 1 17. An abrasive-jet cutting system, according to claim
2 12, wherein:
3 said first means comprises a store of liquid, a
4 liquid pressurizing device, and means for conducting
5 liquid from said store to said device.
- 1 18. An abrasive-jet cutting system, according to claim
2 17, further including:
3 fifth conduit means for communicating said vessels
4 with said store for conducting liquid from said vessels
5 to said store.
- 1 19. An abrasive-jet cutting system, according to claim
2 18, further including:
3 a control valve, interposed in said fifth conduit
4 means, having means operative, in a given one of two op-
5 erative modes of said control valve, for (a) effecting
6 communication between one of said vessels and said store,
7 and (b) prohibiting communication between another of said
8 vessels and said store, and having means operative, in
9 the other of said two modes, for (c) effecting communica-
10 tion between said another vessel and said store, and (d)
11 prohibiting communication between said one vessel and
12 said store.
- 1 20. An abrasive-jet cutting system, according to claim
2 19, further including:
3 means intercoupling said control valve and said
4 given, single valve for causing coincident change of said
5 valves between said operative modes thereof.



